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MINERALOGY.—*A worked jade pebble from Copan.*[1] H. S. WASHINGTON, Geophysical Laboratory, Carnegie Institution of Washington.

During his excavations at the ancient Maya city of Copan, Honduras, in 1919, Dr. Sylvanus G. Morley found a flat pebble of jade, (sawn in two and perforated), on the platform of Stela 7.[2] (Fig. 1.) The material of this pebble seemed to be of such interest, and its pebble form argued so strongly for an American provenance, that I expressed a desire to study it. I am deeply indebted to Dr. Morley for the privilege of examining the object, and especially for his liberality in permitting me to remove a few grams for the chemical and microscopical study. It is gratifying to know that the mutilation has yielded some results of interest in connection with the study of American jades.

The pebble has had a wide cylindrical perforation bored into it from each flat side, penetrating almost to the center and tapering slightly inward; it was then sawn in two equatorially down the center about half way between the two flat sides, thus freeing the cylindrical cores of the perforations, which (as Morley states) were probably used for making ear ornaments, either disks or plugs.[3] The width of the equatorial cut was about 5 mm.

With this pebble was found a finely worked and highly polished deep green pendant, 7.5 cm. high, representing a human figure, with the arms crossed over the breast; this figure was intended to hang with the side outward. The weight of this is 87.8300 grams, and I found its specific gravity to be 3.307 at 22°, indicating that it is composed largely of jadeite, with but little of the diopside and albite

[1] Received October 3, 1922.

[2] S. G. MORLEY. *The inscriptions at Copan.* Carnegie Publ. **219**: 105. 1920.

[3] Dr. Morley thinks that the perforation was carried through from side to side; but that it extended only partly through from each side is indicated by the slight traces of a ridge at the bottom edge of each perforation extending a millimeter or so inward around the edge. The saw marks show that the sawing was done in various directions and extended down to the perforation, the marks being tangent to this circle.

molecules present.[4] I have not yet had the opportunity to study the material chemically or with the microscope. It is what appears to be the jade most valued among the Maya.

Dr. Morley informs me that "the nearest monument to these objects is Stela 7, recording the date 9.9.0.0.0. of the Maya Era, or 354 A. D. These jades, however, probably date from a century to a century and a half later."

Fig. 1. Worked jade pebble; Copan, Honduras. A on the right, B on left.

The two pieces are not quite the same size or weight, but they are unquestionably parts of the same pebble. Their general form is shown in fig. 1. The greatest length is about 7.6 cm., the greatest width (B) 5.2 and (A) 5.5 cm., while the smaller (A) is about 5 cm. in greatest thickness and the larger (B) about 1.2. The perforation is circular and of the same diameter in each, 3.3 cm. The smaller (A) weighed 37.3062 grams (before the piece, weighing about 3 grams, was removed by me), and the larger (B) weighs 55.8190 grams.

The curved surfaces are those of the original pebble; they are water-smoothed, but not polished. In color the smaller piece (that

[4] See a forthcoming paper on *The jades of Middle America*, to be published in Proc. Nat. Acad. for 1922.

which was analysed) is of a nearly uniform, pale gray green, between Ridgway's pea- and sage-green. The larger is decidedly whitish on the natural surface, which shows slight pitting; and this has evidently been somewhat weathered, as is also shown by its lower density. On the sawn face it is of about the same color as the other. The texture of both pieces is very fine-grained, indeed quite aphanitic. The material shows the lack of toughness which is characteristic of the Middle American jades.

The specific gravity of the smaller piece was determined by me as 2.934 at 19.4°, giving a density of 2.929; while Dr. L. H. Adams obtained the density value 2.932 for the same piece. The true density may be taken as 2.930. Adams found that the density of the larger, whitish piece is 2.756.

In thin section the jade (of piece A) is seen to be composed largely of clear albite in irregular poikilitic patches, not as the sharp anhedral grains or angular interstitial areas which are most commonly seen in other Middle American jades. Through this albite matrix is interspersed, not uniformly, considerable pyroxene, of an extremely faint brownish color, not pleochroic. Some of the pyroxene forms rather large (0.5 mm. long), roughly prismatic grains; much of it is in small (up to 0.3 mm. long), sharp prisms; but most of it is in small irregular grains, which appear to be due to crushing. There is no definite general orientation of the pyroxene crystals, and they tend to be felted where they are most thickly crowded. No other minerals were seen in the section.

Dr. H. E. Merwin kindly determined the refractive indices of the pyroxene and found the values: $\alpha = 1.665, \gamma = 1.693, \gamma - \alpha = 0.028$ These values are close to those of artificial diopside ($CaMgSi_2O_6$): $\alpha = 1.664, \gamma = 1.694, \gamma - \alpha = 0.030$. As will be shown presently this Copan pyroxene is composed of about 71.5 per cent of diopside and 28.5 of jadeite, leaving out of account the probable presence of some albite in solid solution. This is more fully discussed in the forthcoming paper mentioned above.

A chemical analysis was made of a portion of a small wedge (weighing about 3 grams) which was sawn out of the end of (A) the smaller and fresher piece. The analysis, made on material dried at 110°, gave the results in table I.

The analysis of the Copan jade differs widely from those of other jades, from Chichen Itza, and other localities in Mexico, and Central

America, made by me and others, especially in its high silica, rather high magnesia and lime, and low soda. In most respects it is intermediate between the jade of the Tuxtla statuette and that from Chichen Itza shown above. The former is composed entirely of diopside-jadeite (the two being present in about equal amounts), while the latter is about two-thirds albite and one-third diopside-jadeite.

The relations are perhaps better shown when the analyses are recalculated into terms of their mineral molecules.

TABLE I.—ANALYSES OF JADES FROM CENTRAL AMERICA

	1	2	3
SiO_2	62.64	55.50	64.64
Al_2O_3	14.92	12.33	18.83
Fe_2O_3	0.60	1.41	0.46
FeO	1.25	1.33	0.49
MgO	4.31	8.72	1.87
CaO	5.92	12.76	2.62
Na_2O	8.78	6.94	11.25
K_2O	0.23	0.25	0.23
H_2O	1.27	0.30	0.16
TiO_2	none	none	none
Cr_2O_3	none	none	0.07
MnO	none	0.05	none
	99.92	99.59	100.62

1. Jade Copan pebble. Washington analyst.
2. Diopside-jadeite, Tuxtla statuette, Washington analyst. H. S. Washington, Proc. U. S. Nat. Mus. 60: Art. 14. 1922.
3. Jade bead, gray-green. Chichen Itza, Yucatan. Washington analyst.

TABLE 2.—ANALYSES OF CENTRAL AMERICAN JADES IN TERMS OF MINERAL MOLECULES

	1	2	3
Orthoclase	1.12	1.67	1.11
Albite	61.31	none	62.61
Anorthite	0.56	1.67	0.28
Jadeite	10.10	45.25	25.25
Diopside	22.60	49.40	9.85
Hypersthene	1.86	0.50	0.60
Magnetite	0.93	1.74	0.70

Here we note the extremely pyroxenic character of the Tuxtla jade (2), while the Copan (1) and Chichen Itza (3) jades contain about the same proportions of albite and pyroxene. In the Copan jade, however, there is about two and a half times as much diopside as jadeite, while in that from Chichen Itza the relation is almost

exactly reversed. It may be said here, anticipating another publication, that the pyroxene in the great majority of Mexican and Central American jades shows a great preponderance of jadeite over diopside. The pyroxene always contains considerable diopside, but only two cases are known in which the diopside and jadeite are present in about equal amount (one being the Tuxtla statuette), while the pyroxene in the Copan pebble is the only one known so far in which diopside dominates greatly over jadeite. This difference is so marked that it gives rise to the thought that, possibly, the Copan jade belongs to a petrographical series of jades which is distinct from the others, and thus possibly comes from a different locality.

BOTANY.—*Two new species of letterwood* (Piratinera). S. F. BLAKE, Bureau of Plant Industry.[1]

The letterwood, snakewood, bois des lettres, or letterhout[2] of commerce is the heartwood of the species of the Moraceous genus *Piratinera* Aubl., all of which are native in the Guianas, the Amazon region of Brazil, and Panama. Aublet, describing the original species, *Piratinera guianensis*, says[3] that it is called "bois des lettres" by the Creoles of French Guiana, and "boutous" by the Galibis, who used the inner wood in making bows and clubs. Canes and pestles were also made from it. A variety with white heartwood, called "bois des lettres blanc," and supposed by Aublet to be only a young state of the same species, was used by the negroes in the manufacture of walking sticks. For this purpose the straightest branches were selected and the bark removed. They were then stained a permanent black with a dye made by mixing soot with the sap of a species of *Inga* known as "bourgoni" (*Mimosa bourgoni* Aubl., now known as *Inga bourgoni* (Aubl.) DC.), and when polished had the appearance of ebony.

Letterwood has been an article of commerce from the earliest settlement of British Guiana. The timber was originally procured from fallen trunks from which the sapwood had long since rotted away. Although such material is still occasionally dug up from the forest floor, the prevailing practice is to fell the timber and split and hew

[1] Received September 26, 1922.

[2] It should be noted that the name "letterhout" is not restricted to species of *Piratinera*, but is used also, as proved by other material received from Professor Record, for *Helicostylis tomentosa* (Poepp. & Endl.) Rusby and a species of *Sahagunia* (?), and the same is true of many others of the vernacular names recorded in this paper.

[3] Pl. Guian. 2: 890. 1775.

off the sapwood in the forest, sending to market the heart portions which are 3 to 8 inches in diameter and 7 or 8 feet long. Its principal use in this country is for the manufacture of walking sticks and umbrella handles. Minor uses include drum sticks, butts of fishing rods, violin and archery bows, and miscellaneous fancy articles. It is also employed to a limited extent in cabinet work, but only in the form of sawn veneers. The native Indians have long used it for making their bows and various other articles requiring great strength and elasticity.[4]

The letterwood trees inhabit the lowlands and not infrequently attain a diameter of two and rarely of three feet. The trunks are long and slender, covered with a smooth bark rich in milky latex, and have a very thick layer of light-colored sapwood surrounding a small, often irregular core of red or reddish-brown heartwood that is as heavy as lignum-vitae. Commercial wood is spotted all over with peculiar black markings which bear some semblance to hieroglyphics and often give to the surface the appearance of snake skin. Not all of the heartwood is figured in this way, and the native cutters cannot tell until they have cut through the sapwood whether the heart will be speckled or only striped with black. It has been supposed that the speckled wood was indicative of a certain species, but studies of sections of tree trunks which accompanied the herbarium material described in this paper prove that this feature is not a specific character.

Prof. Samuel J. Record, of the School of Forestry of Yale University, who is making a thorough investigation of many tropical American woods, has recently sent me for study a considerable number of specimens of Moraceae which he secured from British and Dutch Guiana, including no less than 12 sheets of *Piratinera*, as well as some detached leaves representing other collections. Full credit for the collection of these important specimens should be given to Mr. J. W. Gonggrijp, Conservator of Forests of Surinam, Mr. L. S. Hohenkerk, Forest Officer of British Guiana, and Mr. C. W. Anderson, formerly Forest Officer, whose efforts have provided material for the settlement of one of the many problems connected with the identification of tropical American trees of commercial importance. As preliminary examination of this material showed that it represented three species with distinctive foliar characters, leaves of all three

[4] This paragraph and the following one have been contributed by Professor S. J. Record.

were sent to Dr. A. B. Rendle of the British Museum, who has kindly compared them with Aublet's type of *P. guianensis* and thus established the identity of that species.

It has been customary to refer the name *Piratinera* Aubl. (1775) to *Brosimum* Sw. (1788), and the latter name was made a *nomen conservandum* by the International Botanical Congress at Vienna in 1905. A few years ago, however, Mr. Henry Pittier[5] brought forward evidence to show that the genera were distinct, being separable by the number of pistillate flowers (1 in *Brosimum*, 2 or more in *Piratinera*), and the presence of a perianth in the staminate flowers of *Piratinera*, as well as by differences in the shape of the receptacle. The last feature seems to be of minor significance, but the floral characters brought forward by Pittier are sufficient to justify the separation of the two genera. Another point of interest in the separation of the two genera is brought out in Professor Record's study of the wood of various species. He finds that the heartwood of *Piratinera* is never white, while that of *Brosimum* is always white, except in *B. paraense*, a species of somewhat doubtful generic position.

Five species of *Piratinera* were listed by Pittier,—*P. guianensis* Aubl., *P. discolor* (Schott) Pittier, *P. rubescens* (Taub.) Pittier, *P. acutifolia* (Huber) Pittier, and *P. panamensis* Pittier,—of which only the last two have hitherto been represented in the National Herbarium. In the light of the material now at hand, the separation of the first two species seems to be unjustified. *Brosimum discolor* Schott, briefly described[6] in 1827, was fully described in 1853 by Miquel,[7] who had examined an authentic specimen. Miquel described the under surface of the leaves as glaucescent and subsericeous-pubescent with short, appressed hairs. This is the diagnostic feature of the species, well represented in Prof. Record's material, which has been identified by Dr. Rendle with the type of *P. guianensis* Aubl., and as no distinguishing characters are apparent in Miquel's long description, it is evident that *P. discolor* (Schott) Pittier should be referred to the synonymy of *P. guianensis* Aubl.

With this reduction, and the addition of the two new species represented in the material sent by Prof. Record, the known species of *Piratinera* are increased to 6. All except *P. rubescens* are now rep-

[5] Contr. U. S. Nat. Herb. 20: 96–100. 1918.

[6] In Spreng. Syst. Veg. 4: 403. 1827.

[7] In Mart. Fl. Bras. 4: 110. 1853.

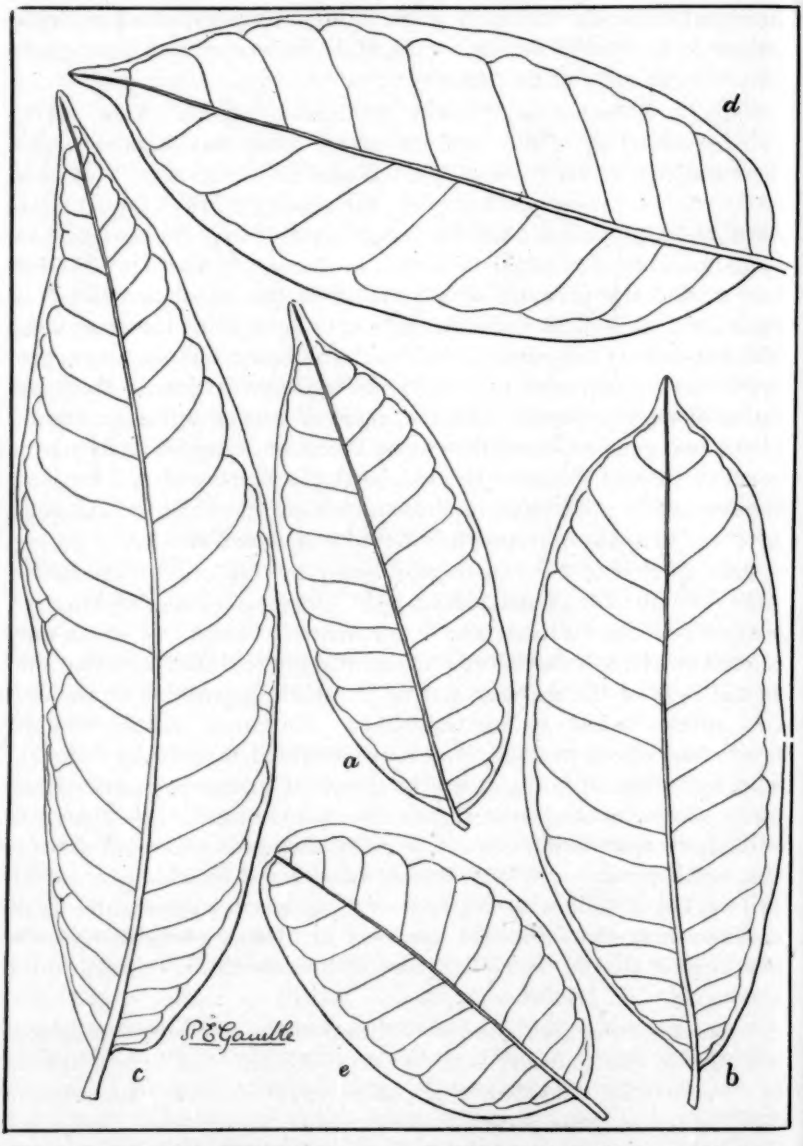

Fig. 1. Leaves of *Piratinera*, natural size.—*a*, *P. guianensis* Aubl. (*Anderson* 598A); *b*, *P. panamensis* Pittier (type collection); *c*, *P. acutifolia* (Huber) Pittier (*Ducke* 12155); *d*, *P. velutina* Blake (type); *e*, *P. scabridula* Blake (type).

resented in the National Herbarium. The following key based chiefly on the leaves will serve to separate the species.

Leaves finely appressed-puberulous beneath.

Leaves rather densely appressed-puberulous beneath; peduncles solitary, erect.

Petioles 2 to 5 mm. long; peduncles (in flower and fruit) 3 to 8 mm. long; receptacle in flower 3.5 to 7 mm. wide.

1. *P. guianensis.*

Petioles 5 to 7 mm. long; peduncles (in flower and fruit) 10 to 15 mm. long; receptacle in flower 1 cm. wide or more.

2. *P. panamensis.*

Leaves very sparsely appressed-puberulous beneath chiefly along the costa; peduncles usually paired, refracted. 3. *P. rubescens.*

Leaves densely puberulous to pilosulous beneath with spreading or incurved but not appressed hairs.

Leaves gradually long-acuminate, puberulous beneath with incurved hairs; chief lateral veins 14 to 22 pairs. 4. *P. acutifolia.*

Leaves emarginate or rounded to abruptly short-acuminate, hispidulous or pilosulous beneath with straight spreading hairs; chief lateral veins 8 to 12 pairs.

Leaf blades mostly 4.5 to 7.5 cm. long, 2 to 4 cm. wide, hispidulous along costa above, very densely scabridulous-hispidulous on surface beneath with minute hairs much shorter than the thickness of the leaf tissue. 5. *P. scabridula.*

Leaf blades mostly 7 to 12 cm. long, 3 to 5.5 cm. wide, glabrous above, rather densely velvety-pilosulous on surface beneath, the hairs about as long as the thickness of the leaf tissue. 6. *P. velutina.*

1. **Piratinera guianensis** Aubl. Pl. Guian. **2:** 888. *pl. 340.* 1775. PALE-LEAF LETTERWOOD. Fig. 1, *a.*

Brosimum discolor Schott in Spreng. Syst. Veg. **4**[2]**:** 403. 1827.

Brosimum guyanense Huber, Bol. Mus. Goeldi **5:** 337. 1909.

Piratinera discolor Pittier, Contr. U. S. Nat. Herb. **20:** 100. 1918.

TYPE LOCALITY: Caux, French Guiana.

ILLUSTRATIONS: Aubl. Pl. Guian. *pl. 340.* Miq. in Mart. Fl. Bras. **4**[1]**:** *pl. 33* (as *B. discolor*).

SPECIMENS EXAMINED:

BRITISH GUIANA: Komentyne (Komantin) Creek, Wiruni River, and Berbice River (near savanna of Karaka), February 18, 1910, *C. W. Anderson* 467/C. T. 45 (N, Yale).[8] Essequibo-Rupumuni region, *Anderson* 598A (N, Yale). On hills up to 15 or 20 meters above sea level, Kamuni Creek, Demerara River, *Anderson* 137 (Yale). Issororo Creek, Pomeroon River, June 8, 1909, *Anderson* 308 (Yale).

SURINAM: Zandery I., a station at Km. 45 of railway, November 25, 1915, *Forestry Service* (*Surinam*) 1371 (Yale). Moderzorg, Surinam River, August 8, 1921, *Forestry Service* 5429 (Yale). Sarwa Creek, Mapane, Commewyne River, November 22, 1921, *Forestry Service* 5497 (Yale, fragm. N). Berlyn, Km. 50 of railway, December 13, 1921, *Forestry Service* 5501 (Yale, fragm. N).

BRAZIL: Obidos, Amazonia, December 22, 1907, *Ducke* 9189 (N).

[8] In the citation of specimens, N = U. S. National Herbarium; Yale = herbarium of Yale University.

The vernacular names accompanying the British Guiana material are "letterwood" (no. 598A) and "tibikushi" (*i.e.*, bastard letterwood; nos. 137, 308, 467). No. 308, which consists only of comparatively large leaves (about 11 cm. long, 5.5 to 6 cm. wide) and of a wood specimen (the latter not examined by the writer), is labeled "not true tibikushi." Although considerably larger than those of the other specimens examined, these leaves agree in pubescence, and seem to be clearly referable to *P. guianensis*. No. 137 is said to grow to be a large tree on sandy soil, the bark emitting a sticky substance when cut, and the heartwood being red mottled with black.

The material from Surinam is labeled with the following names: "letterhout," "letterhout (gespikkeld)," "man letterhout" (Dutch); "manletri," "kappewerie letri" (Negro English); "moejé-paulettoe" (Saramacca Bush Negro); "koeréroe," "koléro," "koelero" (Arowak Indian); "paida," "toekoesipaida," "wékérépaida" (Carab Indian)."

In his list of the described species of *Brosimum*, Pittier[9] recognizes *B. guianense* Huber as a valid species distinct from *Piratinera guianensis* Aubl. This course is not in accordance with the rules of nomenclature, since Huber published the name, in the form *Brosimum guyanense*, without description, and cited *Piratinera guyanensis* Aubl. and *B. aubletii* Poepp. as synonyms. Three collections were listed, nos. 4871, 9189, and 9072. The two latter are in the National Herbarium, as mentioned by Mr. Pittier. Investigation of these, in the light of the information recently obtained as to the identity of Aublet's type, shows that no. 9189 is referable to *P. guianensis* Aubl. No. 9072, however, is referable to the new species described beyond as *Piratinera velutina*. In a later note by Huber,[10] cited by Pittier as the place of publication of *B. guianense*, where the wood is described (with the vernacular name given as "muirapinima"), reference is again made to *P. guianensis* Aubl.

2. **Piratinera panamensis** Pittier, Contr. U. S. Nat. Herb. **20:** 100. *pl. 7.* 1918. PANAMA LETTERWOOD. Fig. 1, *b*.

TYPE LOCALITY: Near Puerto Obaldía, Panama.

SPECIMENS EXAMINED:

PANAMA: Hills back of Puerto Obaldía, San Blas Coast, September 2, 1911, *Pittier* 4336 (type collection, N).

The vernacular name of this species is given as "guaímaro." Prof. Record, who has studied wood material collected by Mr. Pittier, informs me that the sapwood is white, and the heartwood dark red with black markings.

3. **Piratinera rubescens** (Taub.) Pittier, Contr. U. S. Nat. Herb. **20:** 100. 1918. REDLEAF LETTERWOOD.

Brosimum rubescens Taub. Bot. Jahrb. Engler **12:** Beibl. **27:** 4. 1890.

TYPE LOCALITY: Brazil. Type collected by Glaziou (no. 12169).

The vernacular name of this plant is given as "páo vermelho."

[9] Contr. U. S. Nat. Herb. **20:** 101. 1918.

[10] Bol. Mus. Goeldi **6:** 168. 1910.

4. **Piratinera acutifolia** (Huber) Pittier, Contr. U. S. Nat. Herb. **20:** 100. 1918. SHARPLEAF LETTERWOOD. Fig. 1, *c*.

Brosimum acutifolium Huber, Bol. Mus. Goeldi **6:** 66. 1910.

TYPE LOCALITY: Primeval woods along the railroad between Belem and Bragança, Pará, Brazil. Type collected by A. Goeldi (no. 8231).

SPECIMEN EXAMINED:

BRAZIL: Rio Branco de Obidos, Pará, 4.8.1912, *Ducke* 12155 (N).

This species is readily recognized by its long-acuminate leaves. The vernacular name is "mururé."

5. **Piratinera scabridula** Blake, sp. nov. ROUGHLEAF LETTERWOOD. Fig. 1, *e*.

Tree with sticky latex; young branches slender, brown or purplish brown, minutely and rather sparsely spreading-hispidulous, glabrescent, the older flaky-barked, becoming gray; buds ovoid, acute, about 2.5 mm. long, finely erect-hispidulous; internodes 2 to 20 mm. long; stipules not seen; petioles 2 to 5 mm. long, sulcate above, finely hispidulous with spreading or erectish hairs; leaf blades elliptic to oval or sometimes obovate-oval, (2.7) 4.5 to 7.5 cm. long, (1.3) 2 to 4 cm. wide, obtuse or obtusely short-pointed to rounded, often emarginate, at base cuneate or rounded-cuneate and unequal, entire, subcoriaceous, above usually light green, shining in age, glabrous except along the hispidulous costa, beneath pale, along costa and chief veins spreading-hispidulous, on surface scabridulous to the touch with very dense and very minute, conical, spreading, whitish hairs, featherveined, the chief veins 8 to 12 pairs, diverging at an angle of 60° to nearly 90°, united inside the margin, flattish or barely prominulous above, prominulous beneath, the costa prominulous above, prominent beneath, the secondaries prominulous-reticulate beneath; peduncles axillary, solitary, erectish, about 7 mm. long, minutely antrorse-hispidulous; young receptacle depressed-hemispheric, about 4 mm. thick, covered with orbicular, peltate, minutely puberulous and ciliolate bracts; ♀ flowers about 5; ♂ flowers numerous, 1-androus, the perianth monophyllous, apparently split on one side; fruit not seen.

Type in the U. S. National Herbarium, no. 1,120,360, collected below Manakobi, on the Corentyn River, British Guiana, December 13, 1909, by C. W. Anderson (no. 406/C8). Duplicate in the herbarium of Yale University.

ADDITIONAL SPECIMENS EXAMINED:

SURINAM: Casipora Creek, Surinam River, November 24, 1921, *Forestry Service* 5495 (Yale, fragm. N). Irakoeka Creek, Surinam River, January 11, 1922, *Forestry Service* 5499 (Yale), 5500 (Yale, fragm. N).

The vernacular name associated with the type is "letterwood." The Dutch names of the other specimens are given as follows: "manletterhout" (5495), "kapiteinhout" (5499), "roode letterhout" (5500). The Arowak Indian name of 5495 is "koelero boelekolle." The label of the type collection states that the flowers were greenish yellow with brown anthers. Unfortunately only a single receptacle has been available for examination, and that is too young and in too poor condition to afford much information, beyond establishing the fact that the plant is certainly a *Piratinera*.

The hairs of the under leaf surface in this species are so small that under a 12x lens they appear merely as densely crowded papillae. Viewed on a cross section of the leaf under a 49x binocular, they are seen to be conical hairs, standing off stiffly at a right angle from the leaf surface, and about one-half to one-fifth as long as the thickness of the leaf.

6. **Piratinera velutina** Blake, sp. nov. VELVETLEAF LETTERWOOD.

Fig. 1, *d*.

Young branchlets brown, finely, densely, and rather softly spreading-puberulous, the older glabrate, gray-barked; internodes mostly 1 to 2.5 cm. long; stipules lance-subulate, 4.5 mm. long, appressed-puberulous on both sides, deciduous; petioles 3 to 5 mm. long, scarcely sulcate above, puberulous like the branchlets; leaf blades oblong to oblong-oval, rarely slightly obovate-oval, (5) 7 to 12 cm. long, 3 to 5.5 cm. wide, abruptly short-pointed with obtuse apex, at base very unequal, broadly rounded on one side, obliquely rounded on the other, entire, subcoriaceous, above deep green, shining, glabrous, beneath paler (brownish or griseous-green when dry), on the chief veins hispidulous-pilosulous with rather soft spreading or antrorse hairs, on surface very densely papillose and rather densely and softly velvety-pilosulous with spreading hairs, featherveined, the chief lateral veins 8 to 11 pairs, diverging at an angle of 60° to 80°, united inside the margin, with the secondaries flattish or delicately prominulous-reticulate above, prominulous-reticulate beneath, the costa prominent beneath; peduncles (very young) solitary, axillary, erect, puberulous, 5 mm. long or less; young receptacles depressed-subglobose, about 4.5 mm. thick, densely covered with orbicular, peltate, puberulous and ciliolate bracts; ♀ flowers 2 or 3; ♂ flowers numerous, 1-androus, the perianth monophyllous, split on one side; fruit not seen.

Type in the U. S. National Herbarium, no. 1,120,361, collected at Sectie O, a forest station at Km. 65 of railway, Surinam, February 15, 1916, by the Forestry Service of Surinam (no. 1647). Duplicate in herbarium of Yale University.

ADDITIONAL SPECIMENS EXAMINED:

SURINAM: Sectie O, November 3, 1915, *Forestry Service* 1158 (Yale), November 22, 1915, *Forestry Service* 1378 (Yale). Irakoeka Creek, Surinam River, January 11, 1922, *Forestry Service* 5498 (Yale).

BRAZIL: Alluvial forest, Rio Mapuera, Amazonia, December 8, 1907, *Ducke* 9072 (N).

The hairs on the under leaf surface of this species are much longer than those of *P. scabridula*, being readily distinguishable with a 12x lens, and about equaling the thickness of the leaf tissue when seen under the binocular.

The species bears the following names: "letterhout," "roode letterhout" (Dutch); "letri," "basra letri" (Negro English); "poevinga," "paulétoe" (Saramacca Bush Negro); "sokoné-biberoe," "belekoro," "koereroe" (Arowak Indian); "paida," "wékéré paida," "tianalin wéivé," "tokoro apolli merie" (Carab Indian).

DOUBTFUL SPECIES

Brosimum aubletii Poepp. & Endl. Nov. Gen. & Sp. **2**: 34. *pl. 148, f. a-d.* 1838.

This species, from the banks of the Rio Huallaga near Yurimaguas, Peru, was stated by its authors to be without doubt identical with *Piratinera guianensis* Aubl. Pittier,[11] however, considers it "probable that it belongs neither to Brosimum nor to Piratinera, but perhaps to Helicostylis." The description and figures of the receptacle and floral parts, however, particularly of the peltate bracteoles, seem to me to indicate that the plant is a *Piratinera*, and that the staminate flowers were overlooked. The difference in range makes it improbable that the plant is identical with Aublet's species. Until more information is secured, it is impossible to dispose of the name definitely.

BOTANY.—Diospyros conzattii, *a new species of persimmon from Mexico.* PAUL C. STANDLEY, U. S. National Museum.[1]

The National Museum has received recently from Prof. C. Conzatti of Oaxaca, Mexico, specimens of a native persimmon which can not be referred satisfactorily to any of the ten species previously listed from the country. The Mexican species of the genus are endemic, with two exceptions—*Diospyros ebenaster* Retz., an East Indian species with large fruit (4 to 7 cm. in diameter or larger), which is widely cultivated, being known commonly as "zapote prieto;" and *D. texana* Scheele, the "chapote" or "chapote prieto," which extends into western Texas. All the Mexican persimmons have edible fruit, whose pulp is usually black at maturity. The species here described is an interesting addition to the known trees of Mexico, especially since the collector has furnished such complete information concerning it.

Diospyros conzattii Standl., sp. nov.

Tree, 10 meters high, the branchlets minutely and sparsely fulvous-puberulent; petioles 4 to 6 mm. long, minutely puberulent or glabrous; leaf blades ovate-oblong or lance-oblong, 5 to 9.5 cm. long, 2.5 to 3.5 cm. wide, acuminate, acute or subobtuse at base, subcoriaceous, glabrous, somewhat lustrous above, the costa depressed, the lateral nerves nearly obsolete, the costa prominent beneath, the lateral nerves also prominent, slender, irregular, 5 or 6 on each side; fruits borne on short stout pedicels; calyx 5-parted, the lobes narrowly lance-oblong or linear-lanceolate, 15 to 18 mm. long, long-attenuate, glabrous or sparsely strigillose outside near the base; fruit depressed-globose, about 4 cm. broad and 2 cm. high, glabrous, green, the pulp black; seeds 5 to 10, strongly compressed, about 13 mm. long and 10 mm. broad, brown, finely rugulose.

Type in the U. S. National Herbarium, no. 1,014,759, collected in the Cafetal San Rafael, Cerro Espino, Distrito de Pochutla, Oaxaca, Mexico, April 24, 1917, by C. Conzatti (no. 3167).

[11] Contr. U. S. Nat. Herb. **20:** 98. 1918.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received September 26, 1922.

Diospyros conzattii is not closely related to any of the species previously reported from Mexico, with the possible exception of *D. blepharophylla* Standl. (*D. ciliata* A. DC.), a little-known plant, the type of which is said to have come from southern Mexico. That is described as having ovate-elliptic ciliate leaves, on longer petioles.

From a manuscript work upon the edible fruits of Mexico, Professor Conzatti has furnished the following notes concerning the new species here described:

"On the twenty-fourth of April, 1917, while making an excursion in the company of Señor E. Makrinius, manager of the Cafetal Concordia and its subsidiaries, District of Pochutla, Oaxaca, on the so-called Cerro Espino, upon which lies the Cafetal San Rafael, I had the good fortune to find among other things a medium-sized (10 meters) tree, known there as *zapote negro montés*. At that time of the year the tree bore leaves and ripe fruits. Sampling the fruits, with some suspicion at first, I found them quite to my taste and ate as many as I could. But I prefer to quote what I have already published in the *Boletín de la Dirección de Estudios Biológicos*:[2]

" 'The *zapote negro montés* is especially interesting because of its edible fruit, of exquisite flavor. With the exception of the *chicozapote*, I know of no other fruit which compares in quality with the *zapote negro*, and all the persons who have tried it are agreed in considering it superior to that. The fruits, which are perfectly round, and green outside, are much smaller than those of the common *zapote negro* (*Diospyros ebenaster*), being only 4 cm. in diameter and 2 cm. or slightly more in height, since they are somewhat depressed.

" 'It seems to me that propagation of the tree should be relatively simple, taking into account the elevation (1,000 meters) at which it grows and the fact that it is native.' "

BOTANY.—*A new Salvinia from Trinidad.*[1] WILLIAM R. MAXON, National Museum.

In Christensen's Index Filicum 13 species of water fernworts of the genus *Salvinia* are recognized, these mainly inhabitants of tropical regions. Of the few American species, *S. sprucei*, known from a single collection in the Amazon region, has been unique in having ascending, somewhat cup-shaped leaves, in distinction from the plane blades of the small floating leaves of other species. Recently a new species closely allied to *S. sprucei* has been collected in Trinidad. This is described below.

[2] II. 3: 316. 1918.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received September 6, 1922.

Salvinia cyathiformis Maxon, sp. nov

Plants small, 1 to 1.5 cm. long, 1 cm. broad, or less; stem filiform (about 0.3 mm. thick), bearing a few deciduous short few-celled hairs. Submerged radiciform leaves imperfect, conceptacles wanting. Floating leaves few, 2 or 3 pairs (the nodes 3 or 4 mm. apart), petiolulate (about 0.5 mm.), olivaceous above, darker beneath, 5 to 6 mm. long, subflabelliform, cyathiform, truncate-subcordate at base, broadly rounded in the apical portion, not emarginate, conduplicate in drying, the folded blade 4 to 5 mm. broad, appearing cuneiform, with an acutish or narrowly roundish-cuneate base; midvein slight, subflexuous, hardly thicker than the lateral veins; main lateral veins 6 or 7 pairs, connected in oblong areoles oblique from the midvein, each areole subtending two narrowly oblong or linear areoles toward the margins, the excurrent veinlets mostly free, occasionally producing a minute areole; papillae numerous on the upper side in a wide marginal zone 1.5 to 2 mm. broad, linear, about 1 mm. long, borne mostly upon the ultimate cross-veins and between the excurrent veinlets, greenish-hyaline, cleft at the tip.

Type in the U. S. National Herbarium, no. 1,058,520, collected from a pond at Cedros, Trinidad, December 20, 1914, by W. E. Broadway; received from the New York Botanical Garden.

In habit and in form and venation of the floating leaves *S. cyathiformis* resembles *S. sprucei* Kuhn, of Brazil, founded on *Spruce* 1636. That species as described and figured in the Flora Brasiliensis, and as known to the writer from a portion of the type collection courteously lent from Kew, has the leaves much less deeply cup-shaped, broadly cuneate, and devoid of papillae upon the upper surface, except for a few at the extreme margin that are so minute as to have escaped Kuhn's attention. The leaf substance of *S. sprucei* is much thinner than that of *S. cyathiformis*, and the venation is in consequence much more sharply defined.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

WASHINGTON ACADEMY OF SCIENCES

162ND MEETING

The 162nd meeting of the Academy, the 24th annual meeting, was held at the Administration Building of the Carnegie Institution of Washington, on Tuesday, January 10, 1922. The meeting was called to order by Vice-President HUMPHREYS. Dr. ALFRED H. BROOKS, retiring President of the Academy, delivered an address, entitled, *The scientist in the Federal service.* This has since been published in the JOURNAL of the Academy (12: 73–115. Feb. 19, 1922).

Following the address the annual business meeting was held. The minutes of the 21st annual meeting were read and approved. The Corresponding Secretary, ROBERT B. SOSMAN, reported briefly on the activities of the Academy during the year. On January 1, 1922, the membership consisted of 6 honorary members, 3 patrons, and 534 members, the total being 543, of whom 325 reside in or near the District of Columbia. Nine resignations were accepted during the year, and the Academy lost by death the following

members: EDWARD CHESTER BARNARD, FREDERIC PERKINS DEWEY, LOUIS ALBERT FISCHER, FRANZ A. R. JUNG, EDWARD BENNETT ROSA, SAMUEL STOCKTON VOORHEES. Other matters dealt with included the movement initiated by the Botanical Society of sending scientific literature to the scientists of Russia, the wider distribution of the JOURNAL to Continental European countries, and the compilation by the committee of the Academy of a list of 100 popular books in science. The list, prepared at the suggestion of Dr. GEORGE F. BOWERMAN, Librarian of the Public Library of the District of Columbia, has been widely circulated and commented upon. The activities of the Academy in advocating the establishment of a national arboretum and botanical garden on Mount Hamilton were also discussed.

The Recording Secretary, WILLIAM R. MAXON, reported also on the nine public meetings held during 1921, in addition to the annual meeting, at which illustrated lectures were delivered. Several of these were held jointly with one or more of the societies affiliated with the Academy. The titles and dates, and the place of publication of the lectures, were stated.

The report of the Treasurer, R. L. FARIS, showed total receipts of $6,382.79 and total disbursements of $6,196.89; the cash balance on hand December 31, 1921, was $1,978.52. Investments of the Academy have a total par value of $15,036.37. The cost of printing the JOURNAL in 1921 was $3,701.23, as against $2,550.00 for 1919 and $2,873.74 for 1920.

The report of the Auditing Committee, consisting of W. R. GREGG, S. H. AYRES, and E. G. FISCHER, was read and the reports of the Treasurer and the Auditing Committee were accepted.

The report of the Editors of the JOURNAL was read by ROBERT B. SOSMAN, the senior Editor. Various economies, including change in make-up and in size of page, had made possible the publication of 537 pages in Volume 11, equivalent to about 620 pages of former volumes. Original articles, 53 in number, took up 61 per cent of the pagination, Proceedings of the Academy and the Affiliated Societies 18 per cent, Abstracts 11 per cent, and News, Notes and Index the remaining 10 per cent.

The Committee of Tellers, consisting of H. W. BEARCE, ROBERT H. LOMBARD, and ROBERT B. SOSMAN, reported that the following officers had been elected for 1922: *President*, W. J. HUMPHREYS; *Corresponding Secretary*, F. B. SILSBEE; *Recording Secretary*, WILLIAM R. MAXON; *Treasurer*, R. L. FARIS; *Non-resident Vice-Presidents*, G. E. HALE, D. C. MILLER; *Managers Class of 1925*, L. J. BRIGGS, ROBERT B. SOSMAN.

The following vice-presidents, nominated by the affiliated societies, were then elected: *Archaeological Society*, AUSTIN H. CLARK; *Biological Society*, VERNON BAILEY; *Botanical Society*, CHARLES E. CHAMBLISS; *Chemical Society*, R. C. WELLS; *Institute of Electrical Engineers*, R. P. PARROTT; *Society of Engineers*, J. S. CONWAY; *Entomological Society*, S. A. ROHWER; *Society of Foresters*, RAPHAEL ZON; *National Geographic Society*, FREDERICK V. COVILLE; *Geological Society*, G. W. STOSE; *Historical Society*, ALLEN C. CLARK; *Medical Society*, A. W. BOSWELL; *Philosophical Society*, E. C. CRITTENDEN.

163D MEETING

The 163d meeting was held jointly with the Philosophical Society of Washington in the Assembly Hall of the Cosmos Club, the evening of Saturday, January 28, 1922. Dr. L. T. TROLAND, Professor of Psychology at Harvard University, delivered an address on *Psycho-physics as the key to metaphysics.*

This has been published in the JOURNAL of the Academy (**12**: 141–162. March 19, 1922).

164TH MEETING

The 164th meeting of the Academy was held jointly with the Geological Society of Washington in the Assembly Hall of the Cosmos Club, the evening of Thursday, February 2, 1922. Prof. H. A. BROUWER of the Geological Institute, University of Delft, Holland, delivered an illustrated address, entitled *The major tectonic features of the Dutch East Indies*. This has been published in the JOURNAL (**12**: 172–185. April 4, 1922).

165TH MEETING

The 165th meeting of the Academy was held jointly with the Anthropological Society of Washington in the Assembly Hall of the Cosmos Club, the evening of Thursday, February 16, 1922. Dr. H. U. SVERDRUP, of Amundsen's Arctic Expedition, delivered an address, entitled, *Customs of the Chukchi natives of northeastern Siberia*. A full abstract of this lecture has been published in the JOURNAL (**12**: 208–212. April 19, 1922).

WILLIAM R. MAXON, *Recording Secretary*.

PHILOSOPHICAL SOCIETY

865TH MEETING

The 865th meeting was held in the Cosmos Club auditorium April 8, 1922, with President CRITTENDEN in the chair, and 28 persons present. The President announced that a custom formerly prevailing—that of affording opportunity for the presentation of informal communications—would be a regular feature of programs in the future.

The following papers were presented:

F. H. SMYTH: *Experimentation at high pressures and temperatures, with special reference to the fusion of calcium carbonate* (illustrated).

The essential apparatus necessary for work at high pressures and temperatures are (1) a strong-walled gas-proof container or bomb, and (2) an electric furnace within the bomb with which temperatures up to 1500 degrees may be obtained. Electrical leads for the furnace and for the thermo-elements used in measuring furnace temperatures, may be brought out through small holes in the bomb wall, insulated and made gas-tight by soapstone plugs rammed in under pressure around the wires.

For pressures up to 1000 atm. a bomb of nickel steel of 10 cm. internal diameter, and 20 cm. depth, with a wall 7 cm. thick has been found satisfactory. The bomb wall is made with two shells, between which are grooves through which cooling water may be circulated. A small platinum wound resistance furnace of 14 mm. internal diameter is used as a heating element. Owing to the great heat losses due to convection in a gas atmosphere at high pressure, the furnace tube must be well baffled with small discs of refractory material, and the platinum crucible containing the heated charge must be in practically solid contact with the inside furnace wall.

The system studied to date is the two component system CaO–$CaCO_3$.

The best previous work on this system has been done by Boeke (N. Jb. Min. 1912, 1, 91–121) under conditions which permitted pressures up to 300 atm. Boeke reports a reversible change from one form of solid $CaCO_3$ to another at 970 deg. The eutectic between CaO and $CaCO_3$ is given as 1218 deg., and the melting point of pure $CaCO_3$ as 1289 deg. at 110 atm.

The results of the present investigation show that there is no change in solid $CaCO_3$ below the eutectic point. The eutectic lies between 1230 and 1240 deg., the corresponding gas pressures being 34 to 39 atm. The melting point of nearly pure $CaCO_3$ is 1335 deg., at a pressure of 1050 atm. Even under these conditions the fused carbonate contains a fraction of a per cent of lime. To get rid of the last traces of lime would probably require much higher pressures, but the melting point of the carbonate probably would not be greatly raised.

E. D. WILLIAMSON: *The prediction of solubility relations under high pressure from compressibility measurements* (illustrated). Discussed by Mr. HAWKESWORTH.

It is somewhat difficult to make direct solubility measurements under high pressure and it is therefore important to observe that such solubility relations can be accurately and unequivocally determined by indirect methods. The following data must be first obtained: (*a*) a set of equilibrium measurements covering the derived concentration at atmospheric pressure—say, vapor pressure or electro-motive force determinations; (*b*) accurate density determinations at atmospheric pressure; (*c*) compressibility measurements on both solutions and pure substances. The lack of trustworthy compressibility results for solutions has so far made calculations worthless, but this gap is now being bridged.

G. W. MOREY: *The production of pressure in magmas by crystallization* (illustrated). Discussed by Messrs. HUMPHREYS and WHITE. It has been published in full in the JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES, **12**: 219–230, 1922.

At the conclusion of the regular program informal communications were presented by L. H. ADAMS on *The stability of graphite and diamond*, and by W. P. WHITE on *The existence of amorphous material in metals*.

866TH MEETING

The 866th meeting was held in the Cosmos Club auditorium Saturday, May 6, 1922, with President CRITTENDEN in the chair, and 36 persons present. Program:

E. H. BOWIE: *The formation and movement of West Indian hurricanes*. Discussed by Messrs. L. H. ADAMS, HAWKESWORTH, HEYL, KADEL and PAWLING.

The formation and the manner of progression of the cyclones of all latitudes and especially those of the tropics have been perhaps more extensively referred to in the literature of meteorology than any other phenomena of the air. The old hypothesis accounted for their formation by the "clashing" of two or more major air currents, such as those that surge back and forth between the tropics and far northern latitudes. Ferrel took exception to this hypothesis and wrote extensively and rather convincingly on the part that local superheating of the lower air strata had to do with the formation of cyclones. The basis of Ferrel's hypothesis had back of it local heating and the deflective influence of the earth's rotation which gave rise to the counterclockwise circulation of the winds around a central region of warm or relatively warm air. Now, the hypothesis of local thermal convection as applied to the formation of cyclones rests exclusively on the supposition that cyclones are warm up to a considerable altitude. Free-air observations wherever made fail to prove this to be a fact, for in Europe the cyclone is found to be cold or relatively cold, while in the United States, at least east of

the 100th Meridian, the free-air observations disclose the fact that the eastern half of the cyclone is warm and the west half cold. No doubt if similar free-air observations were made in the far northwest in the winter months it would be found that, in cyclones in British Columbia, Alberta, Washington, Oregon and Montana, the western half of the cyclone is warm and the eastern half cold, for certainly the surface distribution of temperature implies just this temperature distribution in the free-air in that region. The inference is that the distribution of temperature in the cyclone is but a question of whence came the air that passes into and out of the cyclone, and that the temperature distribution therein is purely incidental and not fundamental to the origin of the cyclone itself. The other important hypothesis assigned the formation of the cyclone to the more general movements in the air and asks one to look beyond the immediate place of the origin of the cyclone for its cause. The hypothesis is referred to as the "counter-current theory" and its most ardent advocate in recent years has been Bigelow. The more recent presentation by Bjerknes seems but a modified and differently presented account of the part counter-currents have in the formation of cyclones. It is assumed that these counter-currents on passing one another will cause a diminution of the air pressure above the intervening region, a welling up of the surface air strata, and thus bring about instability which will result in the formation of cyclones. It is also assumed that similar air currents passing one another in the reverse direction will bank together and produce ridges of high pressure or anticyclonic areas. The existence of such counter-currents in the tropical and extra-tropical regions is well supported by observations. The deflective force of the earth's rotation is an important adjunct to the counter-current hypothesis and it follows that counter-currents passing one another on the right will maintain a belt of low barometeric pressure and those passing one another on the left will maintain a ridge of high barometric pressure between them. The energy arising from the condensation of water vapor after the cyclone has formed no doubt contributes to its length of life. Attempt is made to account for the progression of cyclones as moving along the region bounded by counter-currents, such as the "Polar Front" named by Bjerknes, although above the cyclone proper the air stream over and on both sides of the cyclone may and no doubt frequently does flow in the same general direction.

E. B. CALVERT: *Radiating the weather* (illustrated). Discussed by C. A. BRIGGS.

Radio is an indispensable factor in the work of the Weather Bureau and since 1902, when the first storm warning was sent out by this means, it has become of constantly increasing importance in the collection of weather reports and in the dissemination of forecasts and warnings. The Weather Bureau early recognized the potentiality of radio telegraphy as an aid to its projects and was a pioneer among Government agencies in engaging in experiments and investigations looking toward developing and improving it. These experiments were begun in 1900 and continued for several years. During this period a transmitter and receiver were developed, the principles of which were in general use for a long time.

Weather observations are collected daily from 210 places in the United States; 30 in Canada; 36 in the West Indies, Cuba and South American countries; 12 in the Pacific and the Far East, including Honolulu, Guam, Midway Island, Philippines, China and Japan; 22 in Europe; 17 in Mexico

and 9 in Alaska, from which a current daily meteorological chart of the northern hemisphere is prepared. These reports are obtained by telegraph, cable, telephone and radio, but the latter is used wholly or in part in connection with the collection and transmission of the observations from Europe, West Indies and South America, the Far East and Alaska. Radio is also used in providing the meteorological services of Europe, the Philippines and Japan with reports from the United States, Canada and Alaska in exchange.

The vessel weather service is an important and exceedingly valuable feature of the work of the Weather Bureau. Radio communications are utilized almost exclusively in connection therewith. Observations are taken regularly on vessels plying the south Atlantic and Pacific oceans, the Caribbean Sea and the Gulf of Mexico. These observations are radioed twice daily to the forecast centers at Washington and San Francisco and are charted in conjunction with land reports. Cyclone and anti-cyclone centers are located over these water areas, their intensity, direction of movement and rate of progress are determined, and forecasts and warnings are broadcast for the benefit of ships of all nations. During the year 1921 about 10,000 observations were received by radio from ships at sea. The value of this service, especially during the hurricane season, in the saving of ships, lives and cargoes is enormous. The dissemination of the forecasts and warnings to ships is accomplished entirely by U. S. Naval radio stations. Comprehensive weather bulletins containing observations from land and sea areas, synopses of barometer distributions over land and sea, wind and weather forecasts for designated ocean zones and storm and hurricane warnings are broadcast twice daily from 5 high-power stations; and local bulletins and forecasts from 31 naval radio stations on the Atlantic, Gulf and Pacific coasts, and on the Great Lakes. This service for the benefit of navigation is the most complete, extensive and effective in the world.

It has not been possible to extend the benefits of the weather forecasts, cold wave, heavy snow, frost and other warnings to the agricultural interests of the country as effectively as to commercial and navigation interests, because of the inaccessibility of a large portion of farmers to the telegraph and telephone lines, and to newspapers by which they are distributed for the most part. The marvellous advance made in radio telephony offers a solution of this difficult and important problem. Farmers in increasing numbers are supplying themselves with receiving sets. The Weather Bureau has taken advantage of the opportunity and a system of broadcasting weather reports and warnings has been inaugurated in the different states. This system now embraces 80 stations in 34 states.

P. R. HEYL: *On a superior limit of n in Fermat's equation.* Discussed by Messrs. HEAL and HUMPHREYS.

If in Fermat's Equation $x^n + y^n = z^n$ we assign any arbitrary value to z we can find a critical value of n above which no integral solution of the equation is possible. This value of n is a slowly increasing function of z; hence by its means no general proof of Fermat's Last Theorem can be arrived at.

VIRGO